DESCRIPTION

SHREDDED TOBACCO FEEDING APPARATUS FOR A CIGARETTE MANUFACTURING MACHINE

Technical Field

The present invention relates to a shredded tobacco feeding apparatus for feeding shredded tobacco to a tobacco band of a cigarette manufacturing machine.

Background Art

In shredded tobacco feeding apparatus of this type, shredded tobacco is pneumatically conveyed in the process of delivery to the tobacco band, to winnow out midribs, ill-cut shredded tobacco (relatively large uncut shreds), etc. included in the shredded tobacco as a material. More specifically, the shredded tobacco feeding apparatus produces an air flow therein that flows toward the tobacco band, and all of the shredded tobacco is made to fall uniformly into the air flow. A major part of the shredded tobacco is borne by the air flow, thus forming a shredded tobacco stream, while relatively heavy shredded tobacco drop down past the air flow. This stage is a primary separation whereby heavy shredded tobacco (most of which are midribs and uncut shreds) are separated from the shredded tobacco.

The heavy shredded tobacco separated out by the primary separation are further subjected to a secondary separation whereby the shredded tobacco is separated into relatively light shreds and relatively heavy shreds. Specifically, the heavy shredded tobacco separated out by the primary separation are released into an upward flow of air, so that relatively light shreds are conveyed upward by

the air flow and join the aforementioned shredded tobacco stream. On the other hand, relatively heavy shreds, such as midribs and ill-cut shreds, drop drown despite the upward air flow and are finally discharged from the shredded tobacco feeding apparatus.

In the process of the second separation, however, if the velocity distribution of the air flow is not uniform, the shredded tobacco fails to be separated smoothly in regions where the flow velocity is relatively low. For example, in the case where the secondary separation is performed in a vertically extending passage, the velocity distribution of the air flow in the passage as viewed in the width direction thereof is such that the flow velocity is lower in widthwise opposite regions of the passage than in the central region. Accordingly, the separation of the shredded tobacco takes place less smoothly in the widthwise opposite regions of the passage than in the central region, possibly causing a situation where shreds that should originally be redirected to the shredded tobacco stream stagnate in the widthwise opposite regions of the passage. Such stagnation hinders smooth separation of the shredded tobacco in the stage of the second separation. Moreover, once the shredded tobacco stagnates, the stagnant tobacco grows upward as shreds are successively fed thereon afterward, possibly causing a situation where the passage is clogged with shreds up to the shredded tobacco stream. Such clogging of the passage with shreds can lead to suspension of the entire cigarette manufacturing machine.

In the field of shred tobacco feeding apparatus, therefore, the clogging of the passage with shredded tobacco should be avoided, and there has been a demand for measures to prevent the clogging.

Disclosure of the Invention

A shredded tobacco feeding apparatus for a cigarette manufacturing machine according to the present invention comprises a feed passage extending to a tobacco band of the cigarette manufacturing machine. Shredded tobacco is made to fall to an inlet of the feed passage to be supplied to the feed passage. Also, the shredded tobacco feeding apparatus produces a flow of air in the feed passage that flows toward a suction surface of the tobacco band, to pneumatically convey the shredded tobacco fallen into the inlet of the feed passage by means of the air flow. The shredded tobacco feeding apparatus further comprises a separation chute and a separation passage. The separation chute has an upper end opening in the vicinity of the inlet of the feed passage and is capable of receiving shredded tobacco that falls down across the air flow. The separation passage has an upper end opening into the feed passage on a downstream side of the separation chute and has a lower end opening downward. The shredded tobacco fallen into the separation chute is collected and delivered to an intermediate portion of the separation passage, and the junction between the separation chute and the separation passage is sealed in an airtight fashion. Also, a flow of air flowing toward the feed passage is produced in the separation passage at a location higher in level than the intermediate portion thereof, thereby allowing outside air to be introduced into the separation passage from the lower end thereof. The shredded tobacco feeding apparatus also comprises detection means arranged in the separation passage at a location lower in level than the intermediate portion thereof for detecting stagnation of the shredded tobacco delivered to the separation passage.

With the shredded tobacco feeding apparatus, all of

the shredded tobacco being fed to the tobacco band of the cigarette manufacturing machine is winnowed by the air flow, and relatively heavy shredded tobacco separated out by this primary separation is supplied to the separation passage for a secondary separation. In the secondary separation, the shredded tobacco is winnowed by the flow of outside air introduced into the separation passage from the lower end thereof. Shredded tobacco that is borne on the upward flow of outside air is introduced into the feed passage, while shredded tobacco falling down despite the upward air flow is finally discharged to outside of the separation passage. In the process of the secondary separation, if the shredded tobacco stagnates within the separation passage, such stagnation is detected by the detection means.

Thus, in the shredded tobacco feeding apparatus of the present invention, stagnation of the shredded tobacco in the separation passage can be detected, so that appropriate measures can be taken at an early stage. It is therefore possible to prevent clogging of the separation passage with shredded tobacco, which often leads to suspension of the entire cigarette manufacturing machine, whereby the cigarette production efficiency and production capacity can be significantly improved.

The detection means may comprise an optical sensor, and the optical sensor is preferably of the type wherein detection light is emitted in the width direction of the separation passage from one side wall thereof and is received on the opposite side wall of the separation passage. Once the shredded tobacco stagnates inside the separation passage, the stagnant tobacco grows in size upward in the separation passage. Since the optical axis of the detection light is directed in the width direction of the separation passage, the stagnant tobacco blocks the

detection light without fail. Sensing the separation passage widthwise permits reliable and efficient detection of stagnation of the shredded tobacco.

The optical sensor may be of a reflection type. In this case, a reflecting mirror is arranged on one of the opposite side walls defining the width of the separation passage, and an optical sensor is arranged on the other side wall. The reflecting mirror has a reflecting surface facing the other side wall, and the optical sensor has a light emitting/receiving surface for emitting the detection light to the reflecting surface and receiving the reflected light.

Numerous particles of shredded tobacco float inside the separation passage and thus may cover the reflecting surface and the light emitting/receiving surface. Accordingly, the detection means preferably includes air blowing means for ejecting air along the reflecting surface or the light emitting/receiving surface. The ejected air serves to prevent the reflecting surface or the light emitting/receiving surface from being covered with particles of shredded tobacco, or to remove the particles already covering the reflecting surface or the light emitting/receiving surface.

More practically, the shredded tobacco feeding apparatus may further comprise alarm means for providing a predetermined alarm when stagnation of the shredded tobacco in the separation passage is detected by the detection means. In this case, the operator of the shredded tobacco feeding apparatus can ascertain the stagnation of the shredded tobacco in early stages and can take appropriate measures (e.g., removal of the stagnant tobacco) promptly thereafter.

Also, the shredded tobacco feeding apparatus may

further comprise removing means for removing stagnation of the shredded tobacco in the separation passage when the stagnation of the shredded tobacco is detected by the detection means. In this case, even if the shredded tobacco stagnates, such stagnation is automatically removed, so that the shredded tobacco feeding apparatus can be operated continuously without the need for maintenance by the operator.

Since an alarm is given upon detection of stagnation of the shredded tobacco, the operator can visually confirm the stagnation and remove the stagnation in early stages. This makes it unnecessary for the operator to constantly watch for stagnation of the shredded tobacco. Further, with the removing means for automatically removing stagnation of the shredded tobacco, the work load on the operator can be mitigated.

Brief Description of the Drawings

FIG. 1 is a diagram schematically illustrating the construction of a shredded tobacco feeding apparatus according to an embodiment;

FIG. 2 is a diagram illustrating the arrangement of a secondary separator in more detail;

FIG. 3 is a sectional view of a part of the shredded tobacco feeding apparatus, taken along line III-III in FIG. 1;

FIG. 4 is a diagram illustrating in detail how an optical sensor is mounted;

FIG. 5 is a sectional view taken along line V-V in FIG. 4; and

FIG. 6 is a diagram illustrating in detail how a reflecting mirror is mounted.

Best Mode of Carrying out the Invention

FIG. 1 schematically illustrates part of a shredded tobacco feeding apparatus according to one embodiment of the invention. The shredded tobacco feeding apparatus has a gravity chute 2 extending in a vertical direction, and a needle roller 4 and a picker roller 6 are arranged at an upper end of the gravity chute 2. Shredded tobacco is made to fall from above the needle roller 4, and as the shredded tobacco passes between the needle roller 4 and the picker roller 6, a controlled quantity of tobacco is fed into the gravity chute 2.

The shredded tobacco feeding apparatus has a feed passage 8 therein. The feed passage 8 extends in a horizontal direction from the lower end of the gravity chute 2, and a primary damper 10 is arranged in a facing relation to the inlet of the feed passage 8. The primary damper 10 emits a jet of air horizontally at a location beneath the gravity chute 2, to supply air into the feed passage 8. The feed passage 8 extends in the direction of air flow from the primary damper 10, is curved upward along an upper surface of a tobacco stream trough 12, and reaches a suction surface of a tobacco band 14.

Tobacco shreds which are relatively light in weight among those dropping from the lower end of the gravity chute 2 are fed into the feed passage 8 by the air flow jetted from the primary damper 10. The tobacco stream trough 12 also has air outlet holes (not shown) formed in its curved surface to eject air therefrom. Consequently, the shredded tobacco fed into the feed passage 8 forms a tobacco stream running toward the tobacco band 14 together with the air flow. On the other hand, relatively heavy shreds drop (pass) across the air flow without being fed into the feed passage 8. Usually, in this primary

separation, about 10% of the whole shredded tobacco is winnowed out. A separation chute 16 has an upper end opening in the vicinity of the inlet of the feed passage 8, and receives the shredded tobacco falling down across the air flow. An air locker 18 is connected to a lower end of the separation chute 16, and the shredded tobacco falling into the separation chute 16 is successively fed into the air locker 18.

A secondary separator 20, which extends vertically inside the shredded tobacco feeding apparatus, has an upper end opening into the feed passage 8 on a downstream side of the separation chute 16 and has a lower end open to outside air. The upper end of the secondary separator 20 is bent in the direction of air flow in the feed passage 8, and air outlet holes (not shown) are formed in the secondary separator 20 in the vicinity of the junction with the feed passage 8 for jetting air from the secondary separator into the feed passage. Air in the secondary separator 20 is guided into the feed passage 8 due to the air jetted from the air outlet holes, so that outside air is introduced into the secondary separator 20 from the lower open end thereof. The thus-introduced outside air creates an upward flow of air inside the secondary separator 20.

The secondary separator 20 is also connected to the air locker 18 at a portion thereof intermediate between the upper and lower ends. A star wheel 22 is arranged in the air locker 18 and has six vanes disposed on an outer periphery thereof for keeping the junction between the secondary separator 20 and the separation chute 16 in an airtight state. Also, as the star wheel 22 rotates, it takes in the shredded tobacco from the separation chute 16 and delivers same successively into the secondary separator 20.

Among the tobacco shreds thus delivered into the secondary separator 20, relatively light shreds are guided upward together with the outside air introduced from the lower end of the secondary separator, and join the tobacco stream in the feed passage 8. Usually, in this secondary separation, about 95% of the shredded tobacco delivered into the secondary separator 20 is returned to the feed passage 8. The remaining relatively heavy shreds, which approximately account for 5%, fall down through the secondary separator 20 despite the upward flow of air and are discharged from the lower open end. The shredded tobacco thus discharged accounts for about 0.5% of the total feed of shredded tobacco from the gravity chute 2 and consists mainly of midribs and uncut shreds. The discharged tobacco is received by an oscillating conveyor 24 and transported to a predetermined processing section.

FIG. 2 illustrates the arrangement of the secondary separator 20 in more detail. The secondary separator 20 has a movable wall 26 and a fixed wall 28, both of which extend inside the shredded tobacco feeding apparatus in a width direction thereof. The movable wall 26 is coupled to a parallel link mechanism 30, and as an adjusting lever 32 is moved up or down, the movable wall 26 moves toward or away from the fixed wall 28 by an amount corresponding to the manipulation of the adjusting lever. Thus, the opening (cross-sectional flow area) of the secondary separator 20 can be adjusted by manipulating the adjusting lever 32, so that the aforementioned discharge ratio of shredded tobacco is controlled in accordance with the opening. A throttling ridge 34 with a triangular cross-sectional form is attached to the fixed wall 28 at a location lower in level than the outlet of the air locker 18, to increase the average flow velocity of air introduced from outside. The increased

flow velocity of air serves to promote the separation of the shredded tobacco delivered from the air locker 18 and also to restrain discharge of shreds that should originally be returned to the feed passage.

FIG. 3 illustrates part of the interior of the shredded tobacco feeding apparatus including the secondary separator 20. The shredded tobacco feeding apparatus has a pair of side frames 36 and 38 on both sides thereof, respectively, and the side frames 36 and 38 constitute opposite side walls of the shredded tobacco feeding apparatus. The secondary separator 20 has a width extending from one of the side frames 36 and 38 to the other, and accordingly, the side frames 36 and 38 also constitute opposite side walls of the secondary separator 20.

The side frame 36 has a reflection-type optical sensor 40 attached thereto, while the side frame 38 has a reflecting mirror 42 attached thereto for reflecting detection light. The optical sensor 40 has an optical axis L extending across the secondary separator 20 in the width direction thereof at a location lower in level than the outlet of the air locker 18 and at the same time higher in level than the throttling ridge 34. The optical axis of the reflection-type optical sensor 40 is easier to adjust than in the case of a transmission type sensor, and thus is suited for the construction wherein the sensor is arranged inside the shredded tobacco feeding apparatus, as in this embodiment.

FIGS. 4 and 5 illustrate in detail how the optical sensor 40 is mounted. The optical sensor 40 is fixed to the outer surface of the side frame 36 through an angle member 44, and a light emitting/receiving window 46 is cut in the side frame 36 in alignment with the optical axis L

of the detection light. A light transmitting cover 48 is fitted in the light emitting/receiving window 46 from inside the secondary separator 20, and has four corners thereof secured to the side frame 36 by screws. Also, a gasket 50 is disposed outside the light emitting/receiving window 46 in close contact with the outer surface of the optical sensor 40 to seal up the light emitting/receiving window.

A deflector 52 is mounted to the inside of the secondary separator 20 at a location lower in level than the transmitting cover 48, and has three air outlet holes directed upward. Air pressure supplied through an air pipe 54 is introduced into the deflector 52 through the side frame 36. The deflector 52 ejects air from its three air outlet holes along the inner surface of the transmitting cover 48, thereby to prevent particles of shredded tobacco from adhering to the inner surface of the cover or to remove the particles already adhering to the cover. This enables the optical sensor 40 to emit and receive the detection light satisfactorily.

FIG. 6 illustrates in detail how the reflecting mirror 42 is mounted. The reflecting mirror 42 is fitted in the side frame 38 from inside the secondary separator 20, and has a reflecting surface disposed so as to face the side frame 36. A light transmitting cover 56 is also fitted in the side frame 38 so as to lie over the reflecting mirror 42. Thus, the reflecting mirror 42 has its surface covered with the transmitting cover 56.

As in the case of the optical sensor, the reflecting mirror 42 also is associated with a deflector 52 and an air pipe 54, both attached to the side frame 38. The deflector 52 ejects air along the surface of the transmitting cover 56, thereby to prevent particles of shredded tobacco from

adhering to the surface of the transmitting cover or to remove the particles already adhering to the transmitting cover. Thus, the reflecting mirror 42 can satisfactorily reflect the detection light from the optical sensor 40.

While the basic construction of the shredded tobacco feeding apparatus according to the embodiment has been described, a detection system for detecting stagnation of shredded tobacco by the optical sensor 40 is schematically shown in FIG. 1. As mentioned above, the separation of shredded tobacco in the secondary separator 20 is normally effected by means of the upward flow of outside air introduced from the lower end of the secondary separator. Inside the secondary separator, however, the flow velocity of air is lower in regions near the side frames 36 and 38 than in the central region, and accordingly, the shredded tobacco is prone to stagnate in such regions, without being separated smoothly. In addition, the passage of the secondary separator 20 is narrowed in the region where the throttling ridge 34 exists, and thus stagnant shreds may be obstructed by the ridge 34 and remain there. If such stagnant tobacco grows up to the optical axis L of the optical sensor 40 and blocks the detection light, a controller 58 detects the stagnation of the shredded tobacco based on a detection signal from the optical sensor 40.

The detection system may include an alarm device 60, for example. For the alarm device 60, an alarm buzzer, an alarm lamp, a display for displaying an alarm message, etc. may be used. The alarm device 60 provides a given alarm in response to an actuating signal from the controller 58. On detecting stagnation of the shredded tobacco (hereinafter merely referred to as "shreds" where appropriate), the controller 58 outputs the actuating signal to the alarm

device 60. In response to the alarm, the operator ascertains that shreds are actually stagnating and opens the front cover of the shredded tobacco feeding apparatus to remove the stagnant shreds, for example. The movable wall 26 is made of a transparent acrylic plate, and accordingly, the interior of the secondary separator can be visually examined with ease.

Also, a means for actively removing the stagnation of shreds may be incorporated in the detection system. Such removing means is implemented, for example, by an air vibrator 62 attached to the movable wall 26. The air vibrator 62 operates to vibrate the movable wall 26 when supplied with air pressure from a pneumatic device 64. When stagnation of shreds is detected, the controller 58 outputs an actuating signal to the pneumatic device 64, which in turn actuates the air vibrator 62. The movable wall 26 is vibrated by the air vibrator 62, so that the stagnation of shreds in contact with the inner surface of the movable wall is removed.

The output of the actuating signals from the controller 58 may be controlled such that the operations of the alarm device 60 and air vibrator 62 are integrated, for example. Specifically, when stagnation of shreds is detected by the optical sensor 40, the controller 58 first actuates the air vibrator 62 in an attempt to remove the stagnation. If the stagnation of shreds is removed (i.e., if no stagnation of shreds is detected any longer) after the air vibrator 62 is actuated for a predetermined time or a predetermined number of times, the controller 58 stops actuating the air vibrator 62 without operating the alarm device 60. On the other hand, if the stagnation of shreds fails to be removed (i.e., if the stagnation of shreds is continuously detected), the controller 58 operates the

alarm device 60 to prompt the operator to remove the stagnation.

Also, a timer function for controlling the output of the actuating signals may be incorporated in the controller 58. For example, when stagnation of shreds is detected, the controller 58 starts a built-in timer/counter to measure the time elapsed after the detection of the stagnation and, after a lapse of a predetermined time period, actuates the air vibrator 62 or the alarm device 60. The time period to be measured by the timer/counter may be set as needed in the range of, for example, zero seconds to several seconds. Also, the time period to be measured until the operation of the alarm device 60 is started by the controller 58 may be set appropriately in advance, in order to avoid a situation where the alarm is frequently given due to stagnation of shreds lasting only for a short time.

As described above, the shredded tobacco feeding apparatus of the embodiment has the function of detecting stagnation of shreds in the secondary separator, whereby the load on the operator who watches for clogging of the secondary separator with shreds can be greatly reduced. Also, the detection system can operate the alarm device 60 to urge the operator to remove the stagnation of shreds or actuate the air vibrator 62 to actively remove the stagnation, and thus the stagnation of shreds in the secondary separator 20 is never left unattended for a long time. It is therefore possible to prevent trouble that may possibly lead to suspension of the cigarette manufacturing machine, thus contributing to significant improvement in the operating efficiency of the machine.

Also, the detection light can be satisfactorily emitted/received from/by the optical sensor 40 and

reflected by the reflecting mirror 42, as mentioned above, and accordingly, the detection system ensures high accuracy in detecting stagnation of shreds. Thus, the detection system is free from malfunction, enhancing the reliability of the alarm.

The present invention is not limited to the foregoing embodiment and may be modified in various ways. For example, instead of a single optical sensor 40, a plurality of sensors may be used. In this case, the optical sensors may be arranged one above another, for example, so that the height of stagnant shreds can be detected by stages. Also, in this case, the actuating signal output control by the controller 58 may be modified as follows: In an initial stage of stagnation, for example, the air vibrator 62 is actuated, and as the stagnation develops, the air vibrator 62 is actuated more frequently. Alternatively, as the height of stagnant shreds progressively increases, the volume of the alarm sounded by the alarm device 60 or the content of the alarm message displayed by the alarm device may be changed.

Also, the optical sensor 40 to be used is not limited to the reflection type, and a transmission-type sensor may be used instead. Further, stagnation of shreds may be detected by using other types of sensors, image processing system, etc.

In the foregoing, the air vibrator 62 is exemplified as the means for removing stagnation of shreds, but the stagnation removing means is not limited to the air vibrator alone. For example, the stagnation removing means may be a motor-driven vibrator which is adapted to vibrate the movable wall 26. Moreover, the stagnation removing means may be implemented by a means for jetting air toward the stagnant shreds or by a mechanically movable arm for

removing the stagnation.

List of Reference Numerals

2: gravity chute

4: needle roller

6: picker roller

8: feed passage

10: primary damper

12: tobacco stream trough

14: tobacco band

16: separation chute

18: air locker

20: secondary separator

22: star wheel

24: oscillating conveyor

26: movable wall

28: fixed wall

30: parallel link mechanism

32: adjusting lever

34: throttling ridge

36, 38: side frame

40: optical sensor

42: reflecting mirror

44: angle member

46: light emitting/receiving window

48: light transmitting cover

50: gasket

52: deflector

54: air pipe

56: light transmitting cover

58: controller

60: alarm device

62: air vibrator

64: pneumatic device